CLAIMS:

1. A non-iterative method of forming a time-domain equalizer for a receiver device associated with a channel, the method comprising the steps of:

forming a discrete-time representation of channel response $H(z)$, followed by a discrete-time representation of time-domain equalizer response $A(z)$;

choosing a signal which represents an allowed residual output $B(z)$ of the time-domain equalizer;

arranging the formed signals with a summation device to form an error signal of $E(z) = H(z)A(z) - B(z) = 0$;

inputting a unit one signal to the channel response and deriving the relationships $B(z) = H(z)A(z)$, and $H(z) = B(z)/A(z)$;

deriving an expression for the error signal in terms of coefficients corresponding to $A(z)$, $B(z)$ and $H(z)$;

minimizing the error signal;

deriving the coefficients corresponding to $H(z)$ from the receiver training estimates; and

solving for the coefficients corresponding to $A(z)$ and $B(z)$, wherein $B(z)$ has a degree less than the cyclic prefix C, and the coefficients corresponding to A(z) provide the time-domain equalizer.

2. The method of Claim 1, wherein the step of choosing the signal $B(z)$ includes formulating the signal to have a desired frequency response that is flat over the middle of the band.

3. The method of Claim 3, wherein the signal is also formulated to have raised-cosine roll-off at the edges.

4. The method of Claim 1, wherein the receiver utilizes discrete multitone (DMT) modulation.

5. The method of Claim 1, wherein the steps further include:

19

expressing the discrete-time signal $A(z)$ as a polynomial of the order Z^{-M+1} having coefficients a_j;

expressing the discrete-time signal $B(z)$ as a polynomial of the order Z^{-K+1} having coefficients b_j;

expressing the discrete-time signal $H(z)$ as a polynomial of the order Z^{-N+1} having coefficients h_j, wherein $K < M < N$, and $K <= C$;

expressing the discrete-time signal $E(z) = A(z)H(z) - B(z)$ as a polynomial of the order Z^{N-1} having coefficients e_j;

equating coefficients of the same order on each side of the equation for $E(z)$;

determining the coefficients of e_j in terms of a_j, b_j and h_j from the equated coefficients;

deriving the coefficients h_j from the receiver training estimates; and

minimizing the error signal by solving for the coefficients a_j and b_j such that the error signal is minimized.

6.   The method of Claim 5, wherein the step of minimizing the error signal includes:

determining partial derivatives of the error signal with respect to a_j and b_j;

setting the partial derivatives to zero and solving for the coefficients e_j;

substituting values of the coefficients of e_j in terms of a_j, b_j and h_j and deriving a matrix of equations having the terms a_j, b_j and h_j;

multiplying the matrix times a vector having the desired coefficients arranged as b_0 through b_{K-1} and a_0 through a_{M-1} and setting the product equal to zero;

equating the first desired coefficient b_0 to one;

determine h_j coefficients from receiver training estimates; and

solving for the vector of desired coefficients such that the error signal is minimized.

7. The method of Claim 1, wherein the time-domain equalizer is applied to a DSL-type device.

8. The method of Claim 7, wherein the receiver device is an ADSL Termination Unit - Remote.

9. A non-iterative method of forming a time-domain equalizer for a receiver device using discrete multitone modulation in association with a channel, the method comprising the steps of:

forming a discrete-time representation of channel response having corresponding coefficients;

forming a discrete-time representation of time-domain equalizer (TEQ) response having corresponding coefficients, the channel response and TEQ response being arranged to form a combined response;

choosing a residual output signal of the time-domain equalizer having corresponding coefficients and choosing the signal so that its degree is less than a cyclic prefix C;

arranging the formed signals with a summation device to form an error signal = (combined response) – (residual response);

inputting a unit one signal to the channel response and setting the error signal = 0, and deriving the relationship of (combined response) = (residual response);

deriving an expression for the error signal having corresponding coefficients formed in terms of the coefficients corresponding to the combined response and the residual response;

minimizing the error signal;

deriving the coefficients corresponding to the channel response from receiver training estimates; and

solving for the coefficients corresponding to the TEQ and the residual output signal.

10. The method of Claim 9, wherein the step of choosing a residual output signal includes choosing a signal having a desired frequency response that is flat over the middle of the band.

11. The method of Claim 9, wherein the step of deriving an expression for the error signal further includes:

deriving the coefficients of the error signal in terms of the coefficients of combined response and residual response by equating the terms of like power on either side of the expression.

12. The method of Claim 11, wherein the step of minimizing the error signal includes the steps of:

determining partial derivatives of the energy signal with respect to the coefficients of the TEQ response and the residual response;

setting the partial derivatives equal to zero;

substituting values of the coefficients of the energy signal for coefficients in terms of the channel response, the TEQ, and the residual response, thereafter deriving a corresponding matrix of values;

multiplying the corresponding matrix times a result vector of the desired TEQ coefficients and residual response coefficients;

setting the product equal to a zero vector; and

equating the initial coefficient in the result vector to "1."

13. The method of Claim 9, wherein the order of the residual output signal is chosen to be less than or equal to a specified cyclic prefix.

14. The method of Claim 9, wherein the time-domain equalizer is applied to a DSL- type device.

15. The method of Claim 14, wherein the receiver device is an ADSL Termination Unit - Remote.

22

16. A time-domain equalizer (TEQ) apparatus formed in a non-iterative manner in a processor device having associated storage capability, the apparatus comprising:

a channel having a channel response with corresponding coefficients;

a (TEQ) with a response having stored coefficients, the channel response and TEQ response being arranged to form a combined response;

a residual output signal of the time-domain equalizer, the signal having stored coefficients and chosen so that the degree of the signal is less than a cyclic prefix C;

a summation device for arranging the formed signals into an error signal = (combined response) − (residual response);

a unit one-signal input to the channel response, whereby the error signal is set to zero, and the relationship becomes (combined response) = (residual response);

a set of stored coefficients of the energy signal that are determined in terms of the stored coefficients corresponding to the combined response and the residual response;

whereby the error signal is minimized, the coefficients corresponding to channel response are derived from receiver training estimates, and the coefficients corresponding to the TEQ and residual output signal are derived such that the error signal is minimized.

17. The apparatus of Claim 16, wherein the order of the residual output signal is chosen to be less than or equal to a specified cyclic prefix.

18. The apparatus of Claim 16, wherein the time-domain equalizer is applied to a DSL-type device.

19. The apparatus of Claim 18, wherein the receiver device is an ADSL Termination Unit - Remote.

20. The apparatus of Claim 16, wherein DMT modulation is used.